CLAIMS

WE CLAIM AS OUR INVENTION:

1. A catalyst element comprising:

a substrate;

a thermal barrier coating disposed over the substrate; and

a combustion catalyst disposed over the thermal barrier coating.

2. The catalyst element of claim 1, further comprising a ceramic wash-coat disposed between the thermal barrier coating and the catalyst.

3. The catalyst element of claim 1, wherein the thermal barrier coating further comprises a columnar grained microstructure.

4. The catalyst element of claim 3, further comprising a ceramic wash-coat disposed between the thermal barrier coating and the catalyst.

5. The catalyst element of claim 3, wherein the columnar grained structure comprises a plurality of primary columns each supporting a plurality of secondary branches.

6. The catalyst element of claim 5, further comprising a plurality of tertiary branches supported on the plurality of secondary branches.

7. A catalytic combustor comprising:

a fuel-air mixing device for producing a fuel-air mixture;

a catalytic element disposed downstream of the fuel-air mixing device for receiving the fuel-air mixture, the catalytic element further comprising:

a substrate;

a thermal barrier coating disposed on the substrate; and

a combustion catalyst disposed on the thermal barrier coating for reacting the fuel-air mixture.

8. The catalytic combustor of claim 7, further comprising a ceramic wash-coat disposed between the thermal barrier coating and the catalyst.

9. The catalytic combustor of claim 7, wherein the thermal barrier coating further comprises a columnar-grained microstructure.

10. The catalytic combustor of claim 9, further comprising a ceramic wash-coat disposed between the thermal barrier coating and the catalyst.

11. The catalytic combustor of claim 9, wherein the columnar grained structure comprises a plurality of primary columns each supporting a plurality of secondary branches.

12. The catalytic combustor of claim 11, further comprising a plurality of tertiary branches supported on the plurality of secondary branches.

13. A catalyst element comprising:
a metal substrate;
a thermal barrier coating disposed on the metal substrate; and
a catalytic material at an exposed surface of the thermal barrier coating.

14. The catalyst element of claim 13, wherein the catalytic material comprises one of the group of:

pyrochlores with the formula $A_2B_2O_7$ or AB_2O_6 where A is selected from the rare earth elements and B is selected from the group of zirconium, hafnium, titanium, niobium and tantalum;

perovskites with the formula ABO_3 where A is selected from the group of rare earth elements, alkaline earth elements and manganese, and B is selected from the group of aluminum, chrome, tungsten, zirconium, hafnium, titanium, niobium, tantalum, iron, manganese, cobalt, nickel and chrome;

garnets with the formula $A_3Al_5O_{12}$ where A is selected from the group of rare earth elements;

the hexaluminates $LaAl_{11}O_{18}$, $BaMnAl_{11}O_{18}$, $BaAl_{12}O_{19}$, and $BaMAl_{11}O_{19}$ where M is selected from the group of chrome, manganese, iron, cobalt and nickel; and

spinels with the formula AB_2O_4 where A is selected from the group of alkaline earth elements and B is selected from the group of aluminum, iron, manganese, cobalt, chrome and nickel.

15. A method of forming a catalyst element, the method comprising:

providing a substrate;

depositing a ceramic thermal barrier coating material over the substrate; and

depositing a combustion catalyst material over the ceramic thermal barrier coating material.

16. The method of claim 15, further comprising depositing the ceramic thermal barrier coating by an electron beam physical vapor deposition process to form a columnar grained microstructure.

17. The method of claim 15, further comprising depositing a ceramic wash-coat over ceramic thermal barrier coating material prior to the step of depositing a combustion catalyst material.

18. The method of claim 15, further comprising controlling the step of depositing the ceramic thermal barrier coating material so that a surface of the thermal barrier coating material has a specific surface area of at least 18 m^2/g.

19. The method of claim 15, further comprising depositing the ceramic thermal barrier coating material to have a columnar grained structure having a plurality of primary columns each supporting a plurality of secondary branches.

20 The method of claim 19, further comprising depositing the ceramic thermal barrier coating material to have a plurality of tertiary branches supported by the plurality of secondary branches.

21. The method of claim 16, further comprising controlling deposition parameters during the electron beam physical vapor deposition process to support the development of secondary and tertiary crystalline branches in the columnar grained microstructure.

22. The method of claim 21, wherein the step of controlling deposition parameters comprises controlling at least one of a feed rate, a temperature, a rotation rate, and a chamber pressure.